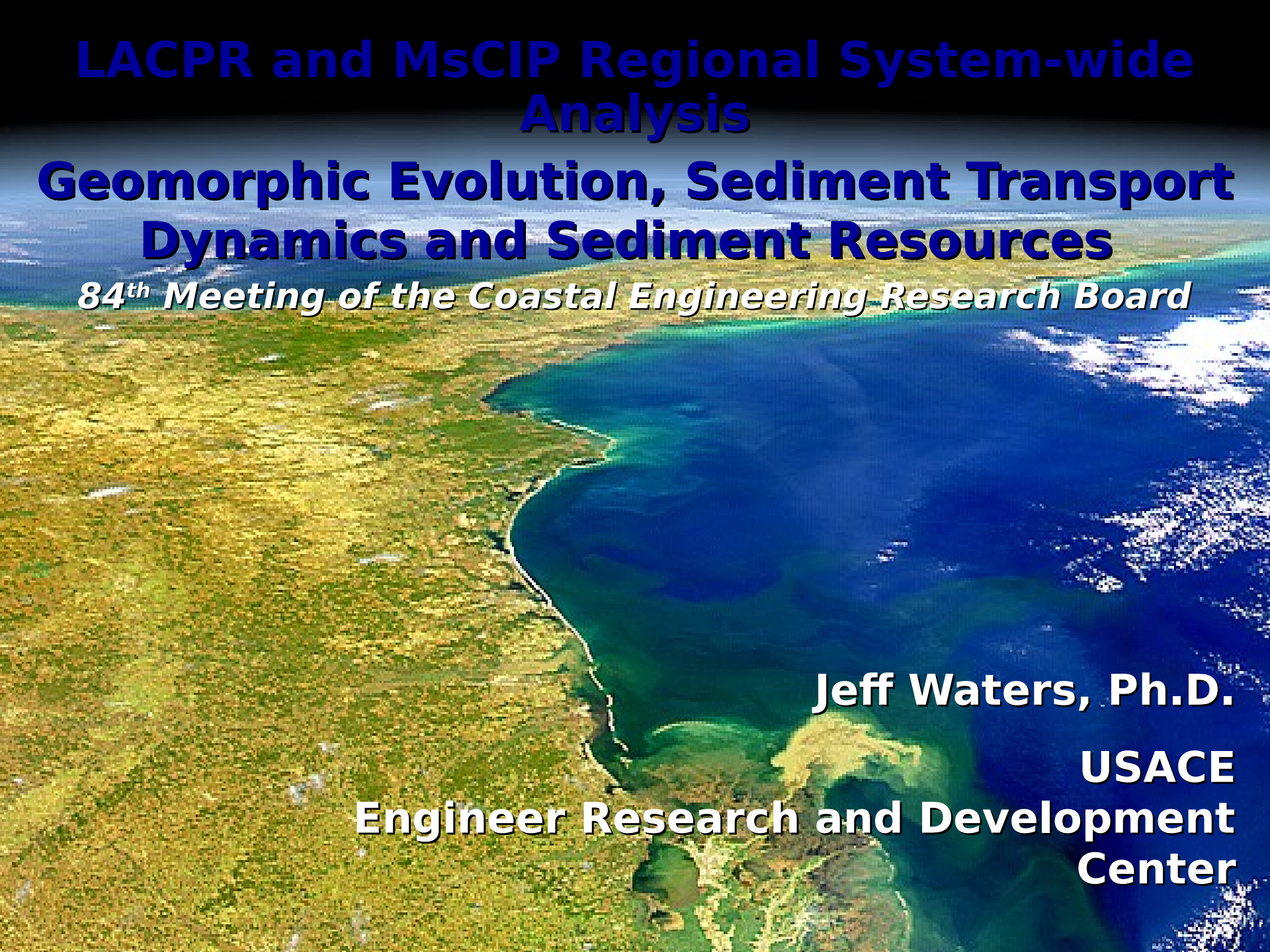
LACPR and MsCIP Regional System-wide Analysis

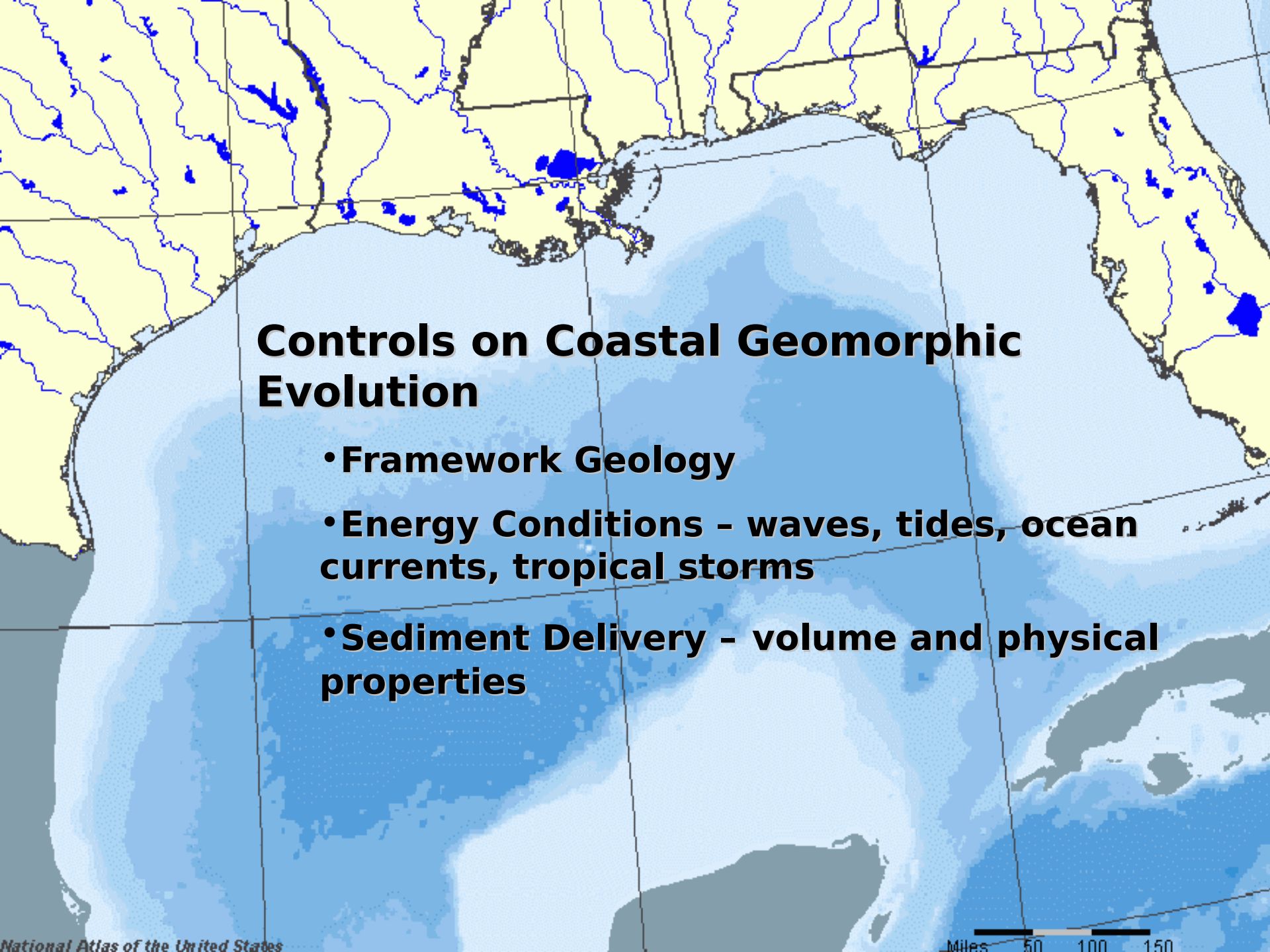
Geomorphic Evolution, Sediment Transport Dynamics and Sediment Resources

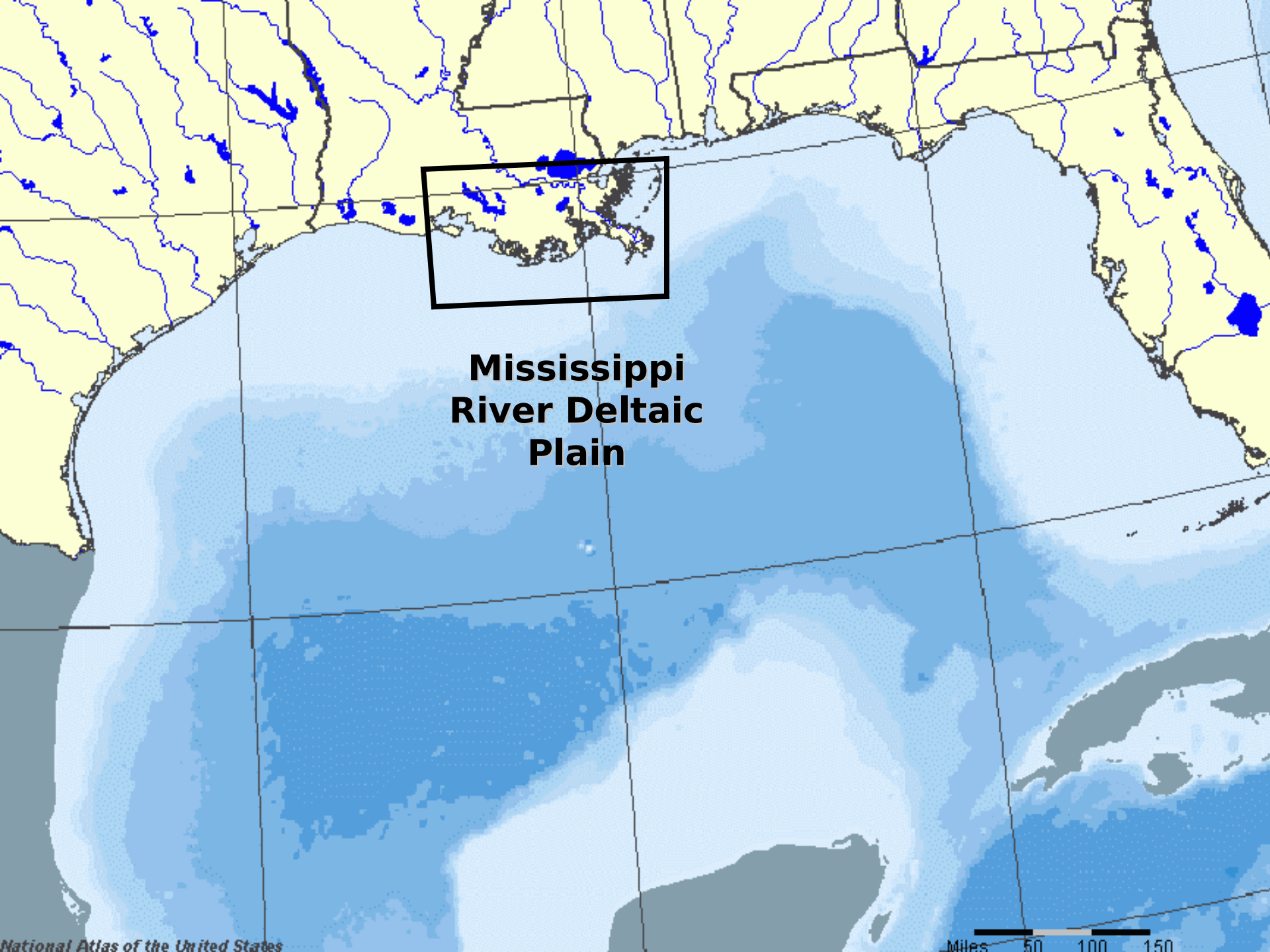
84th Meeting of the Coastal Engineering Research Board



Jeff Waters, Ph.D.

USACE
Engineer Research and Development Center


Controls on Coastal Geomorphic Evolution
•Framework Geology
•Energy Conditions – waves, tides, ocean currents, tropical storms
•Sediment Delivery – volume and physical properties
National Atlas of the United States
Miles
50
100
150


Mississippi
River Deltaic
Plain
National Atlas of the United States
Miles
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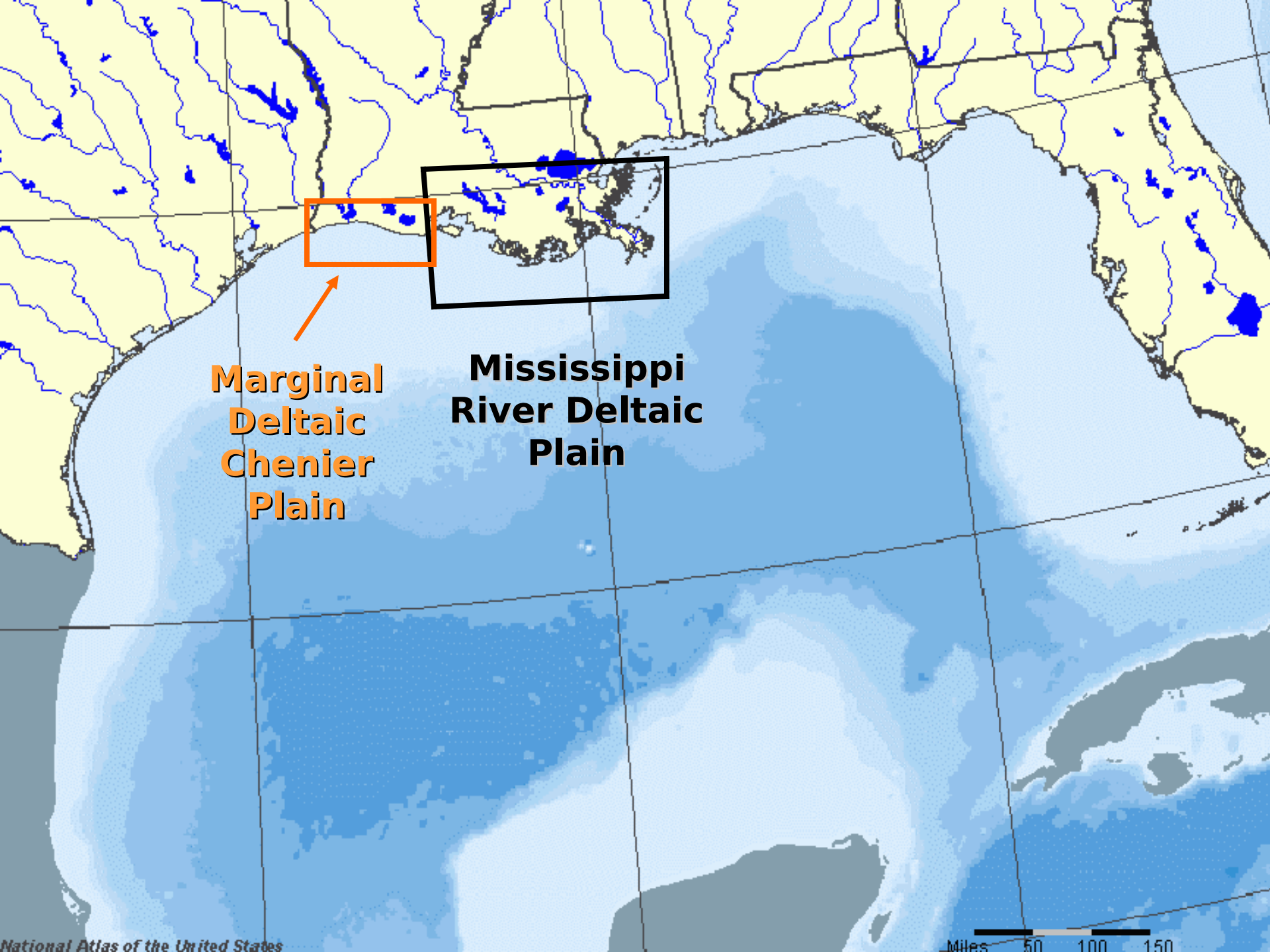
Marginal
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Plain
Mississippi
River Deltaic
Plain
National Atlas of the United States
Miles
50
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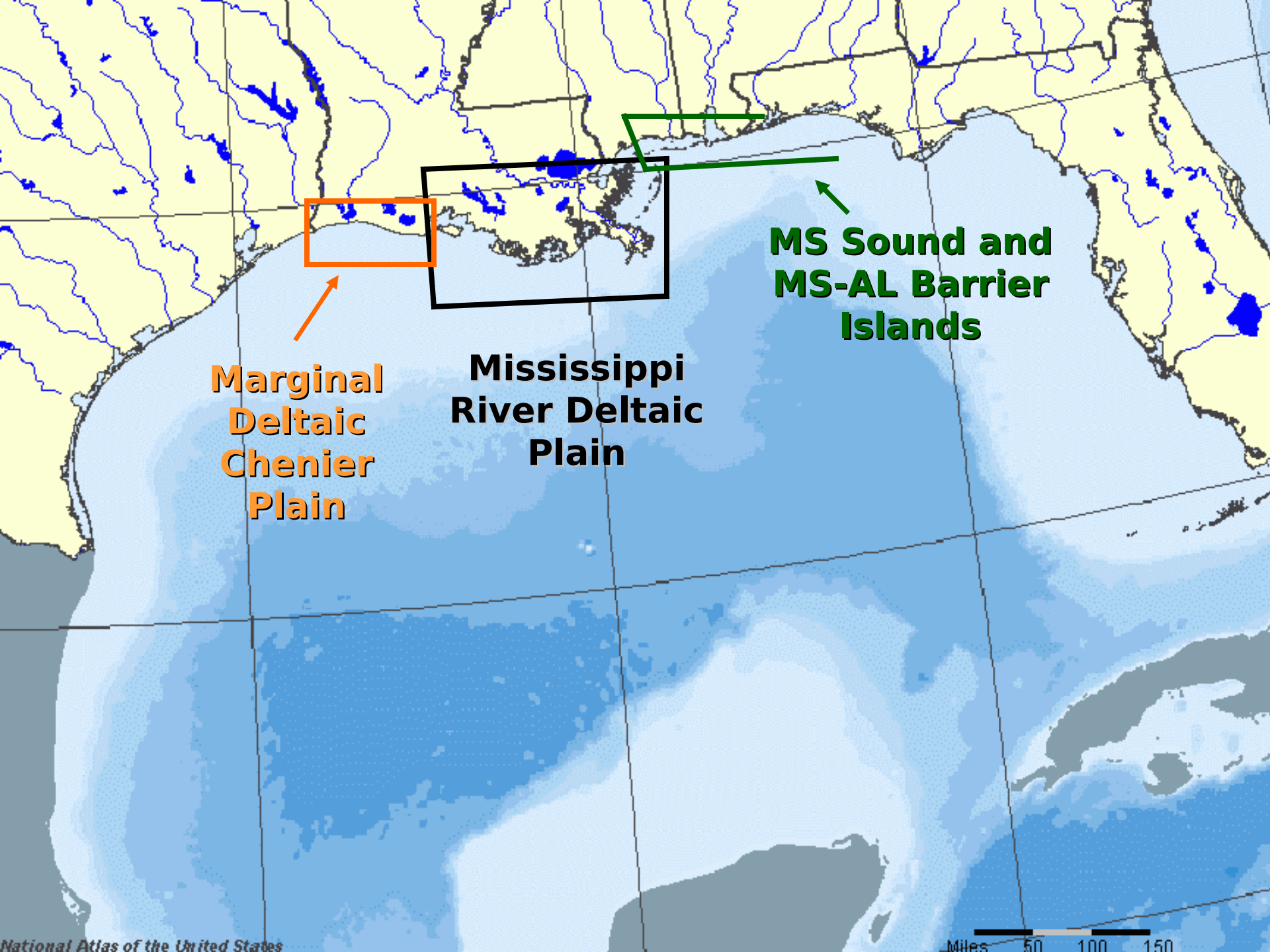
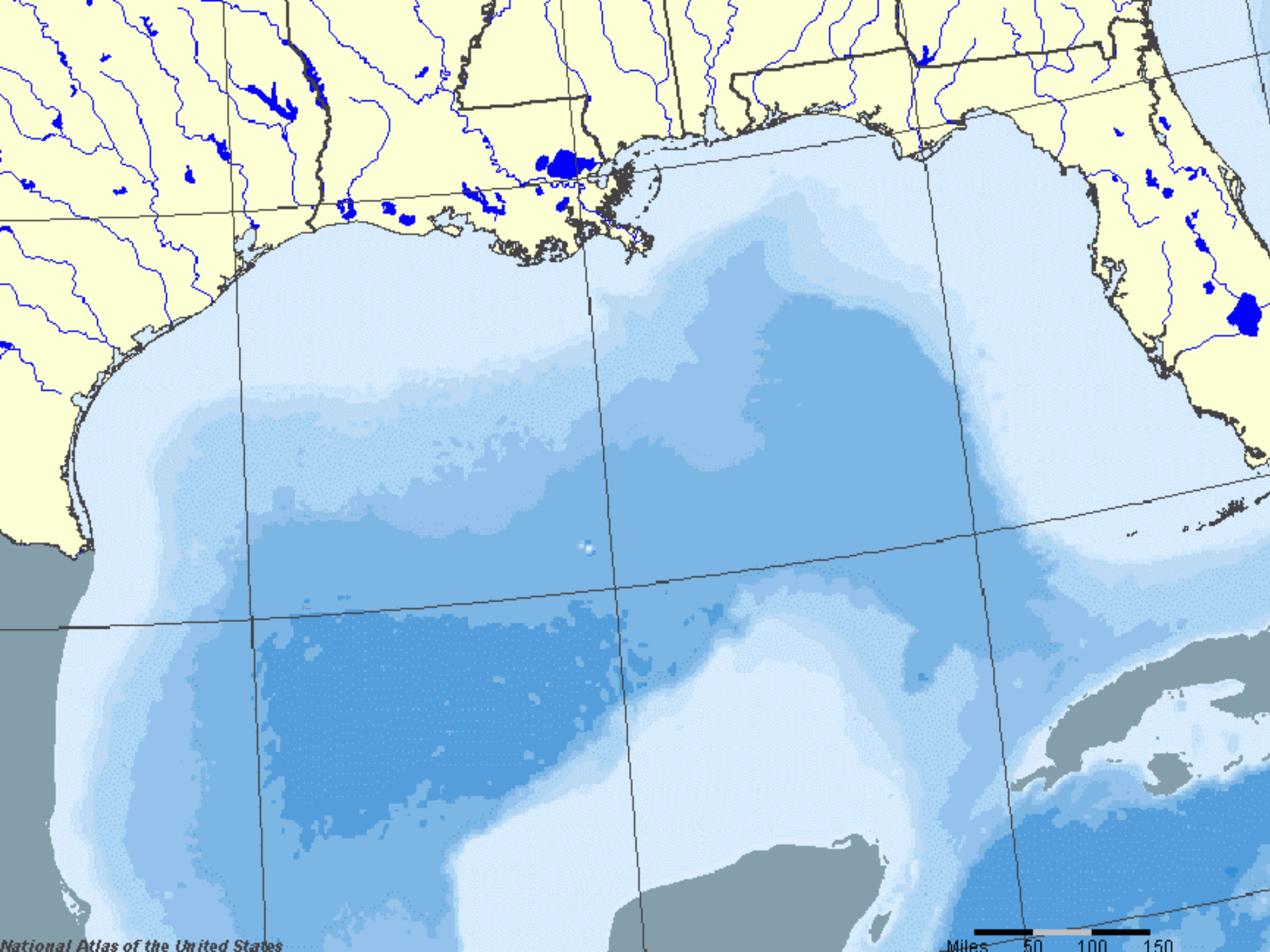

MS Sound and
MS-AL Barrier
Islands
Marginal
Deltaic
Chenier
Plain
Mississippi
River Deltaic
Plain
National Atlas of the United States
Miles
50
100
150


National Atlas of the United States
Miles
50
100
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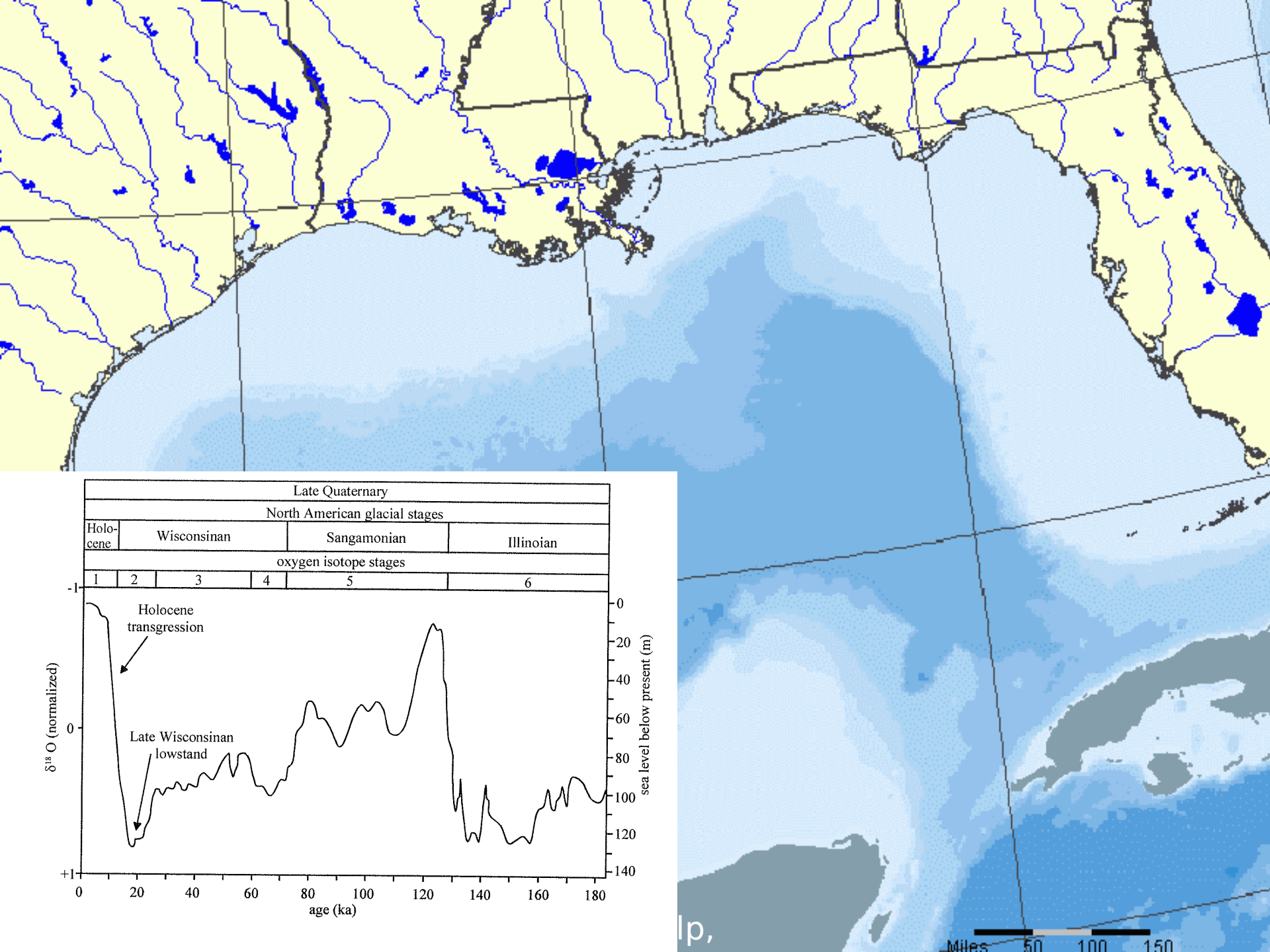
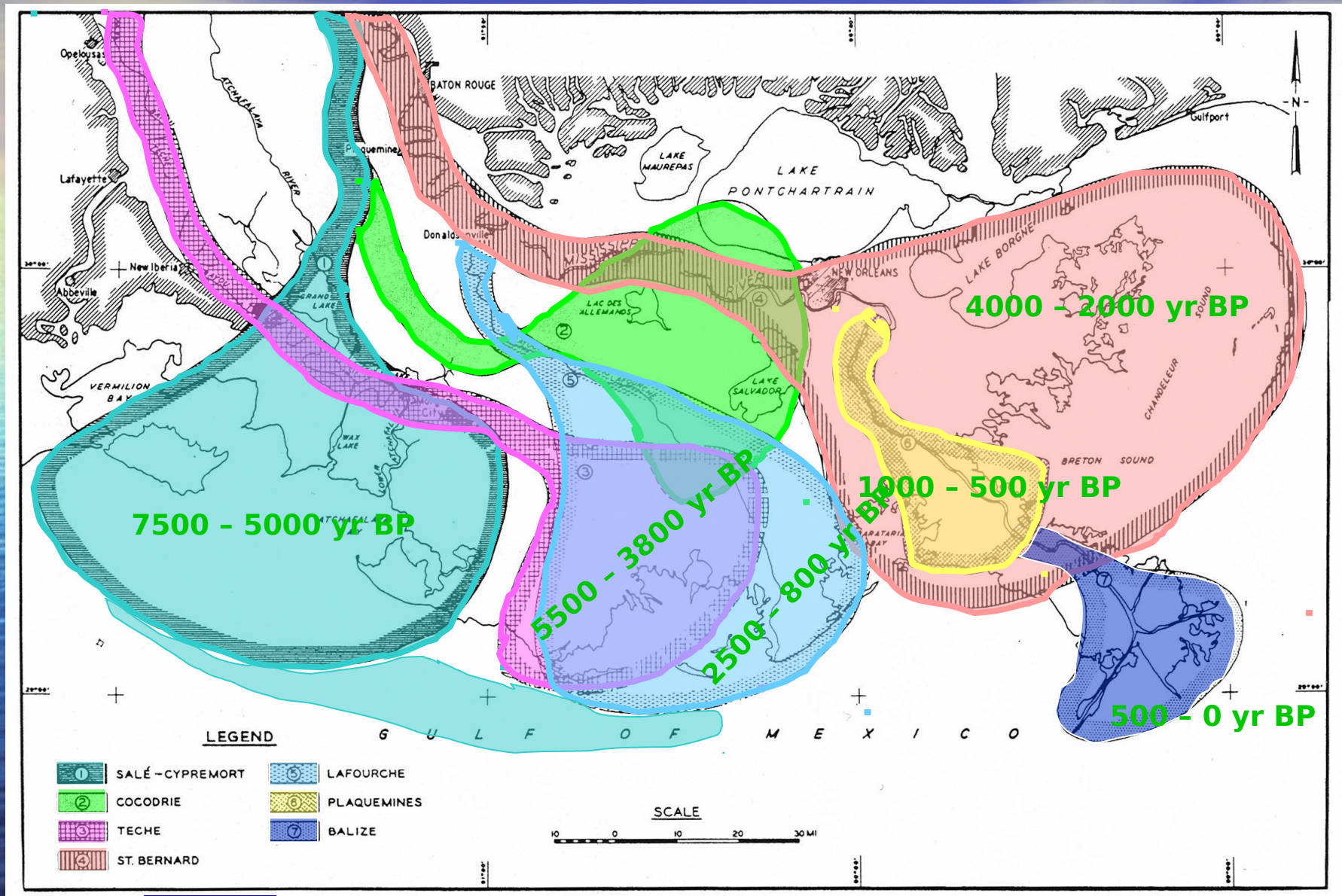

Late Quaternary
North American glacial stages
Holo-cene
Wisconsinan
Sangamonian
Illinoian
oxygen isotope stages
1
2
3
4
5
6
Holocene transgression
Late Wisconsinan lowstand
δ18 O (normalized)
sea level below present (m)
-1
0
+1
0
20
40
60
80
100
120
140
160
180
age (ka)
lp,
Miles
50
100
150

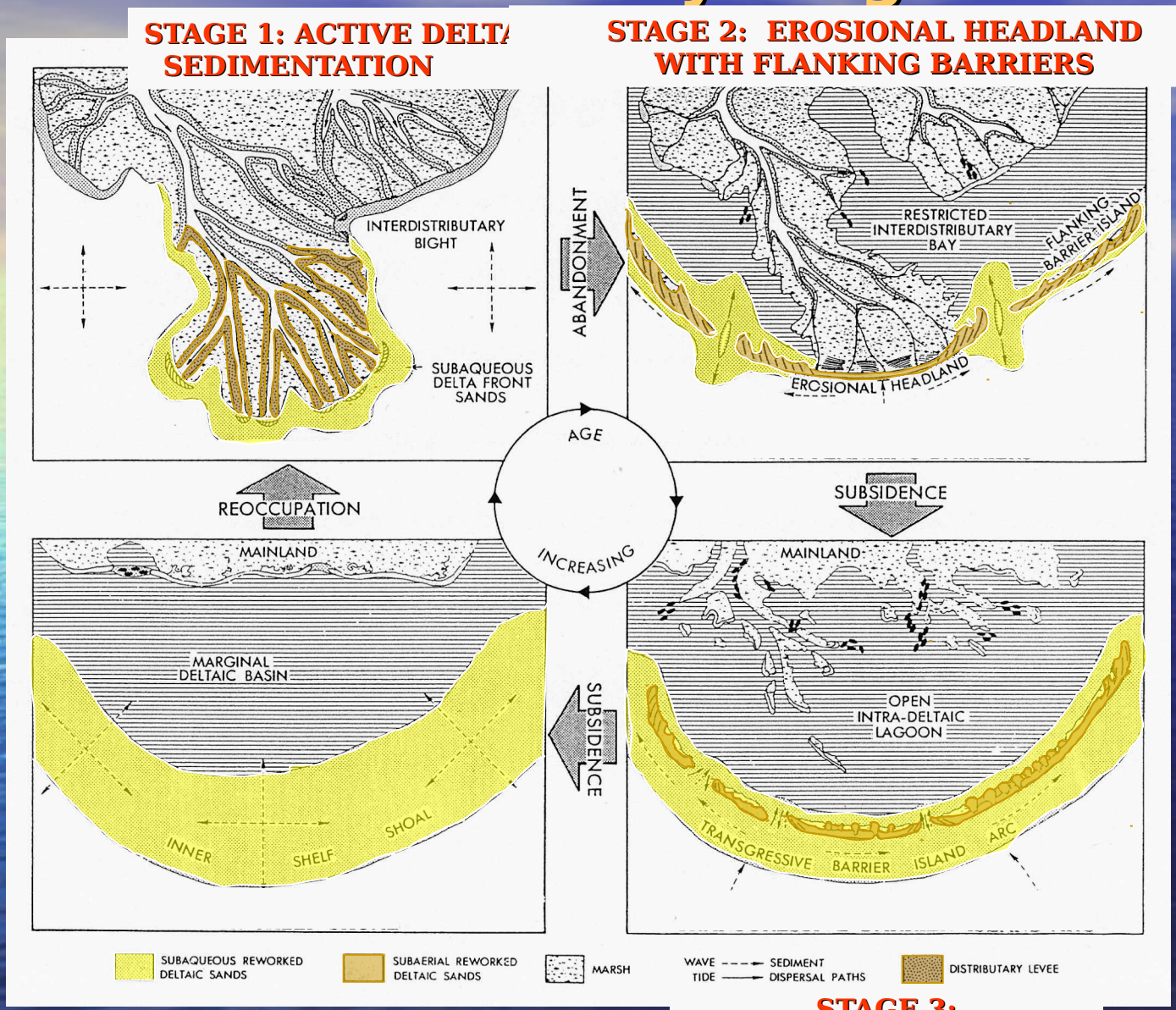
Sequence of Holocene Mississippi Delta Complexes



Chronologic sequence of Holocene Mississippi Delta lobes (from Kolb and Van Lopik, 1966).

7).

Deltaic Evolutionary Stages



Processes

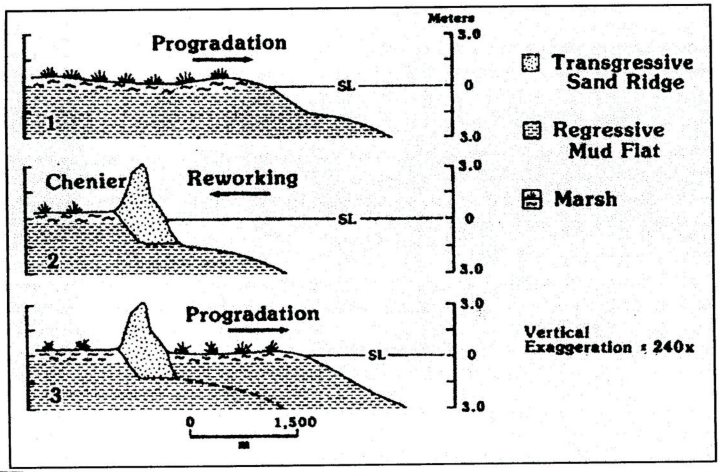
A) Delta River Morphology Growth

B) Eroding Delta Headland forms flanking Barrier Is. & Spits

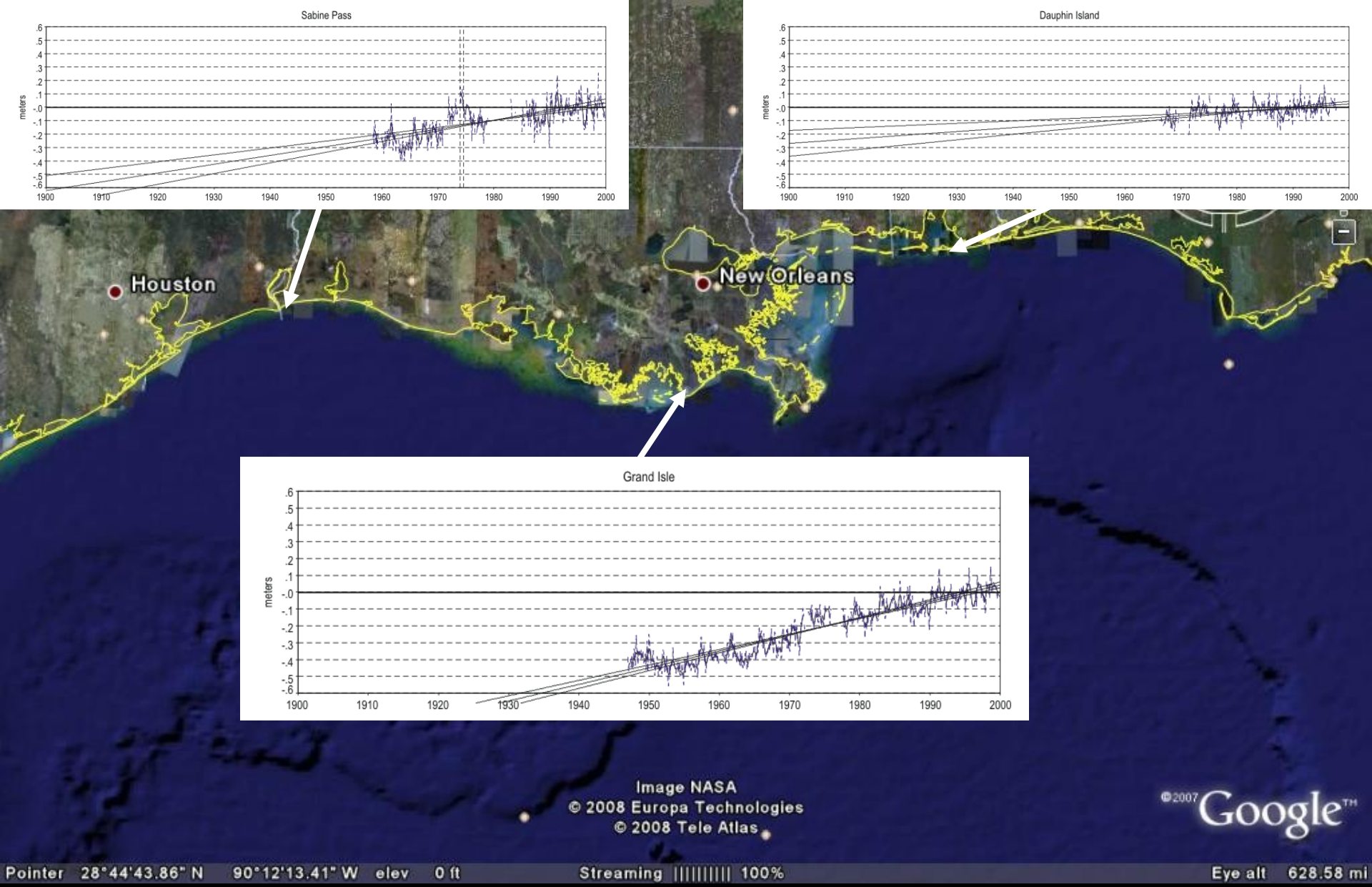
C) Transgressive Barrier Island Arc erosion

D) Loss of Barrier Island only Remnant Shoals left

nland and Boyd, 1985)



Chenier development on prodeltaic sediments. Source: Penland and Suter, 1989.


Sabine Pass
meters
.6
.5
.4
.3
.2
.1
.0
-.1
-.2
-.3
-.4
-.5
-.6
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Dauphin Island
meters
Houston
New Orleans
Grand Isle
meters
Image NASA
© 2008 Europa Technologies
© 2008 Tele Atlas
©2007 Google™
Pointer 28°44'43.86" N 90°12'13.41" W elev 0 ft
Streaming 100%
Eye alt 628.58 mi

10 Km Thick Wedge of Sediment Deposited During Cenozoic Era

Regional Subsidence due to:

- Halokinetics
- Growth Faulting
- Sediment Compaction
- Isostatic Loading

Local Subsidence due to:

- Fluid Withdrawal
- Delta-front Instabilities

Mississippi
Alabama
Mobile Bay
Biloxi
Bayou La Batre
Gulfport
Pascagoula
Mississippi Sound
GIWW
Cat Island
Ship Is. Pass
Ship Island
Dog Keys Pass
Horn Island
Horn Is. Pass
Petit Bois Island
Petit Bois Pass
Dauphin Island
Area of Detailed Analysis
Area Considered for Regional Trends, Sources and Sinks
Navigation Channels

The Gulf of Mexico Alliance:

Implementing the U.S. Ocean Action Plan in the Gulf of Mexico

Gulf Regional Sediment Management Master Plan

Science Assessment Workshop, St Pete, FL

1. Sediment Inventory – Sediment Resource Assessment (Mapping, Volume, Physical Properties, Extractability, Etc.)
2. Sediment Budget - Sediment Transport Dynamics, Sediment Sources and Sinks, Sediment Transport

Sediment Budget Types

- **Conceptual:** Developed quickly (days to weeks); Based on literature review, existing knowledge, observable morphologic change; Used as framework for more detailed budgets.
- **Interim:** "Working Budget"; Data analyzed may include historical data, dredging records, shoreline change, and numerical model calculations; both spatial and temporal domain.
- **Operational:** "Final" budget used in regional planning and project design; likely a series of budgets representing typical years and storm events; uses multiple data sets for redundancy & to develop confidence limits; Can be updated with new knowledge and system changes.

Conceptual Budget

a. Literature review (Cipriani and Stone)

b. GENESIS Transport Rates (Gravens)

Conceptual Budget

Table 11. Comparison of barrier island volumetric change rates for previous studies

Barrier Island	Byrnes et al. (1991) (sq yd/yr)	Volumetric Change based on Byrnes et al. (1991) (thousand cu yd/year)*	Implied Volume Change from Cipriani and Stone (2001) (thousand cu yd/year)	Implied Volume Change from GENESIS modeling (thousand cu yd/year)
Cat	-30,010	-160	n/a	-170
Ship - West	+19,360	+103	-32	-250
Ship - East	-50,330	-270	-14	-255
Horn	-20,330	-108	0	-200
Petit Bois	-23,700	-126	-52	
Dauphin	n/a	n/a	-5	

* Assuming an active depth of 16 ft = 5.3 yd.

c. Comparison of studies

Table 12. Comparison of shoaling rates implied from previous studies

Channel	Present-day Dredging of Bar Channel (thousand cu yd/year)	Implied Shoaling Rate from Cipriani and Stone (2001)	Implied Shoaling Rate from GENESIS modeling
Ship Island Pass	580	52	250
Dog Keys Pass	n/a	0	305
Horn Island Pass	515	52	156
Petit Bois Pass	n/a	0	128

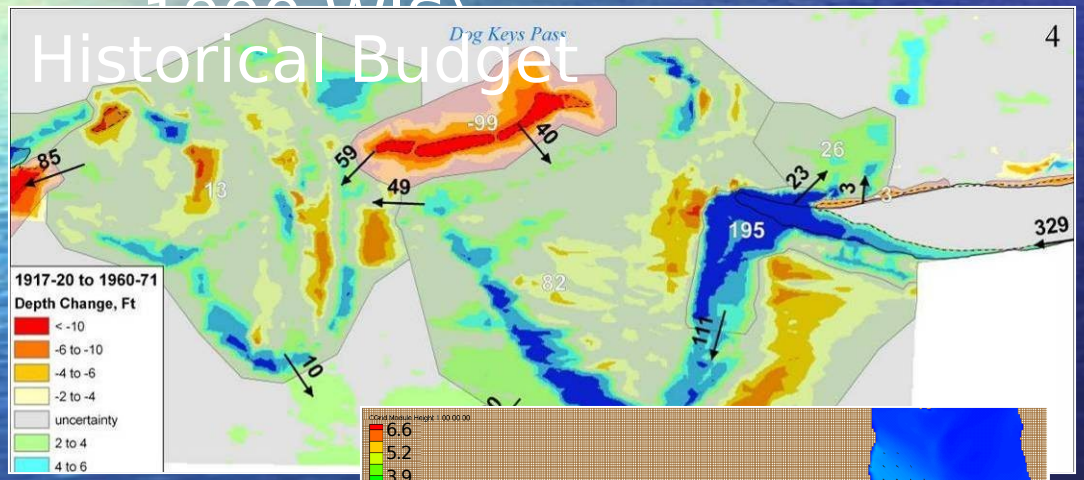
Conceptual Budget

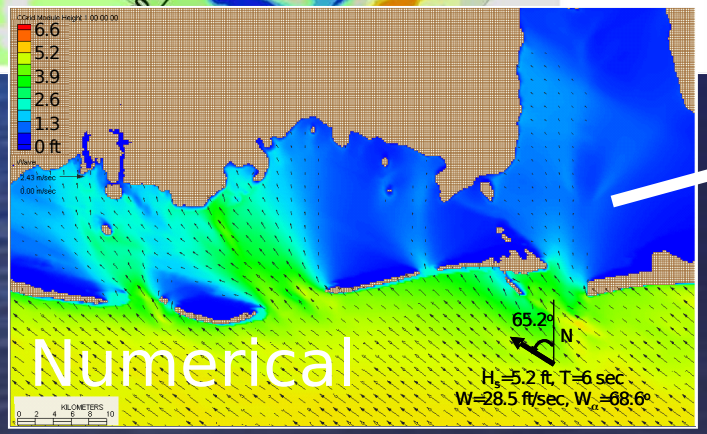
e. Best information put together in final conceptual budget.
Represented all engineering works (channels,

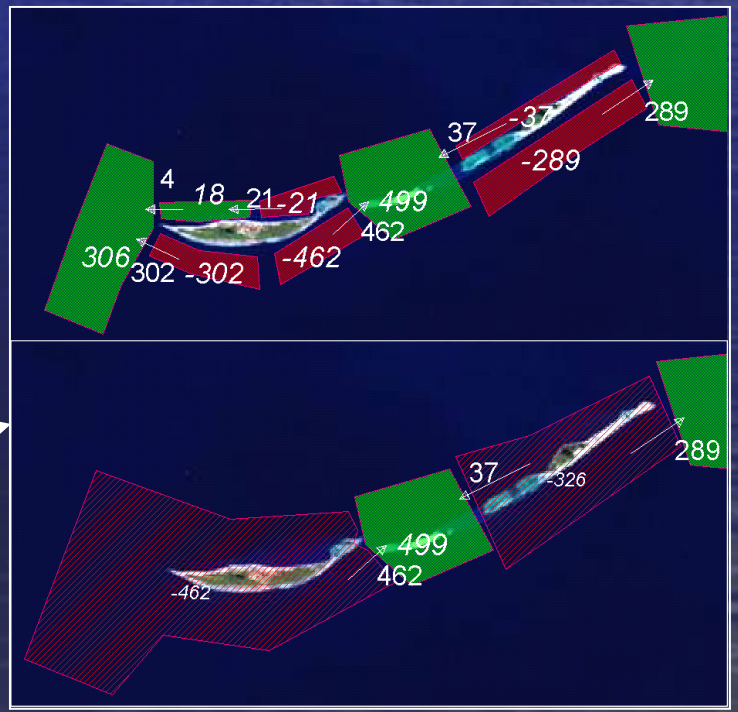
Final MsCIP Conceptual Budget

Interim Budgets

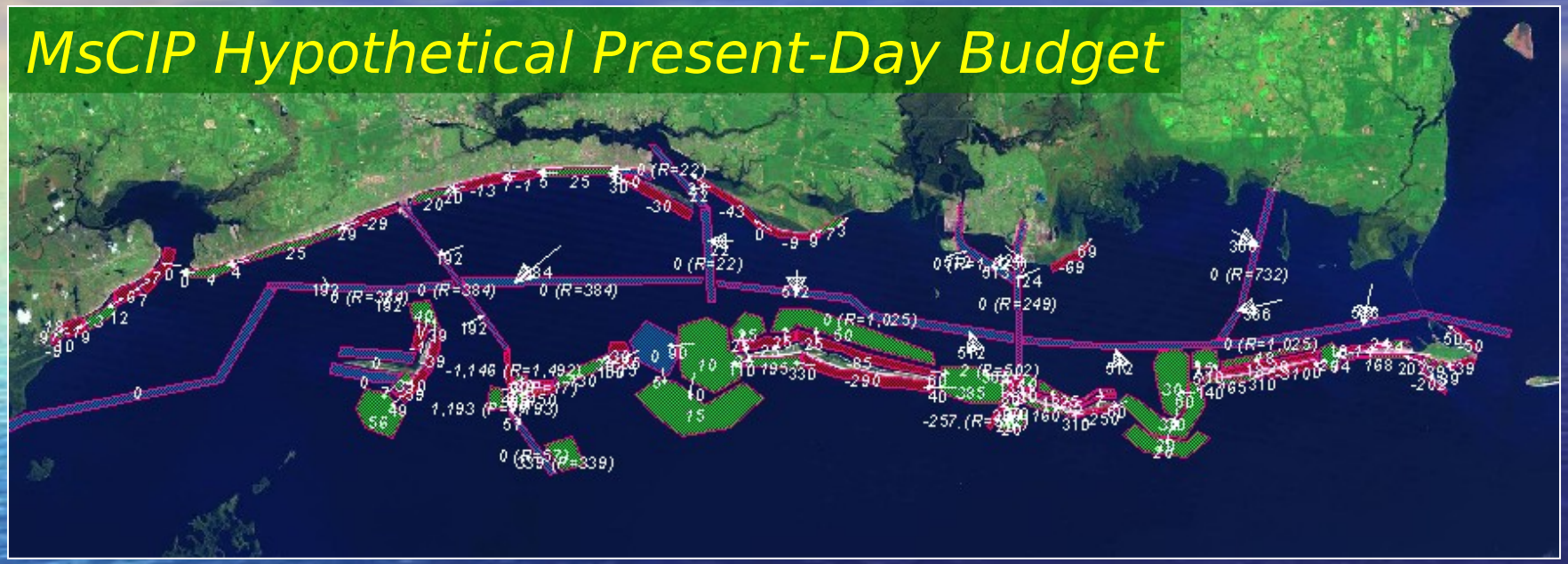
a. Historical (1917/20-1960/71)
b. Numerical (post-Katrina shoreline position; 1980-







Operational Budget

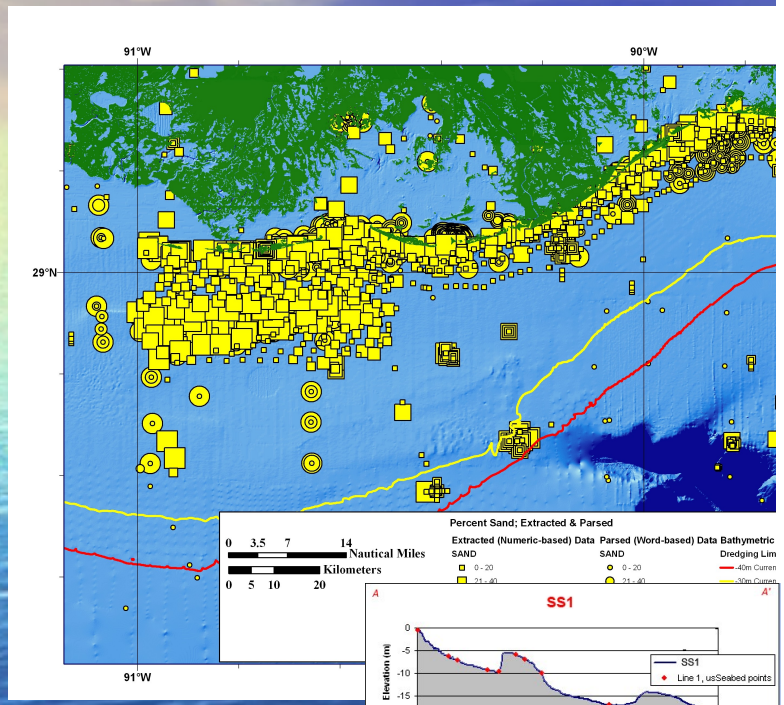


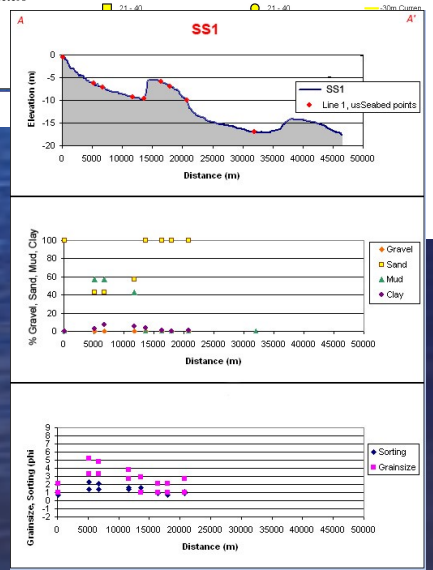
(…not "operational", rather "hypothetical present-day")

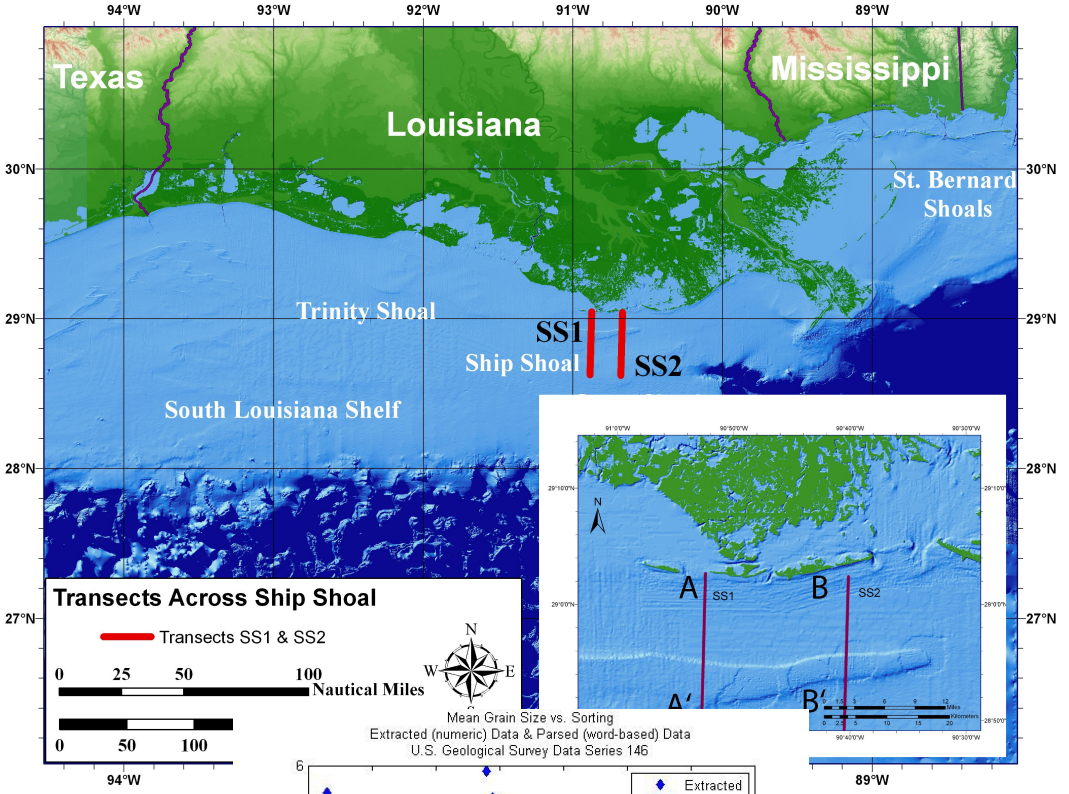
For MsCIP, we weighted historical budget most heavily, with numerical budget filling in unknown information (mainland)

→ For a truly MsCIP Operational Budget, need to

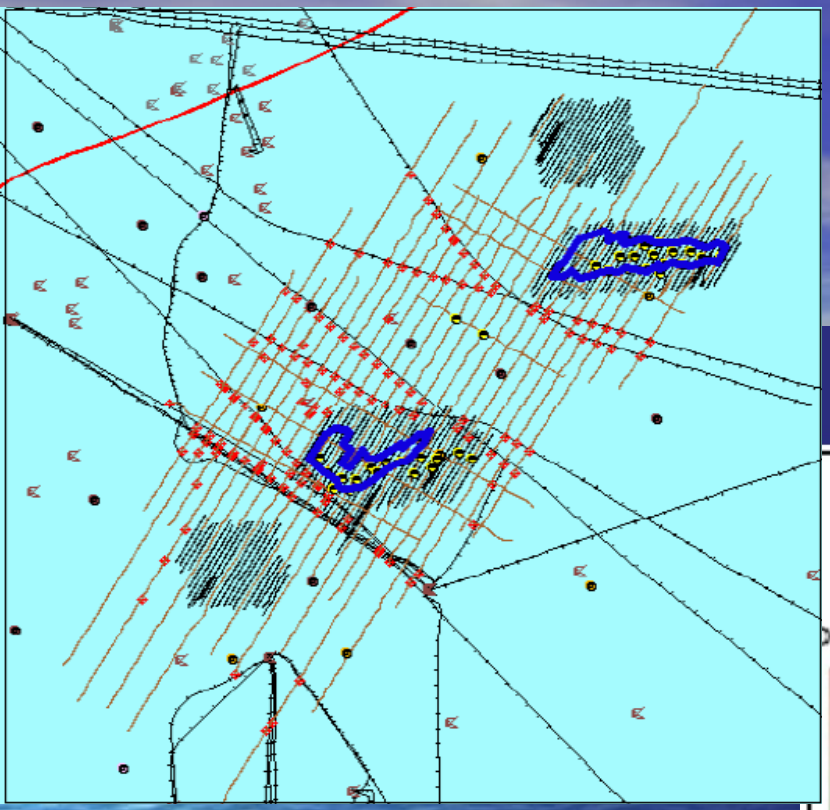
USGS: usSEABED and LASEDS







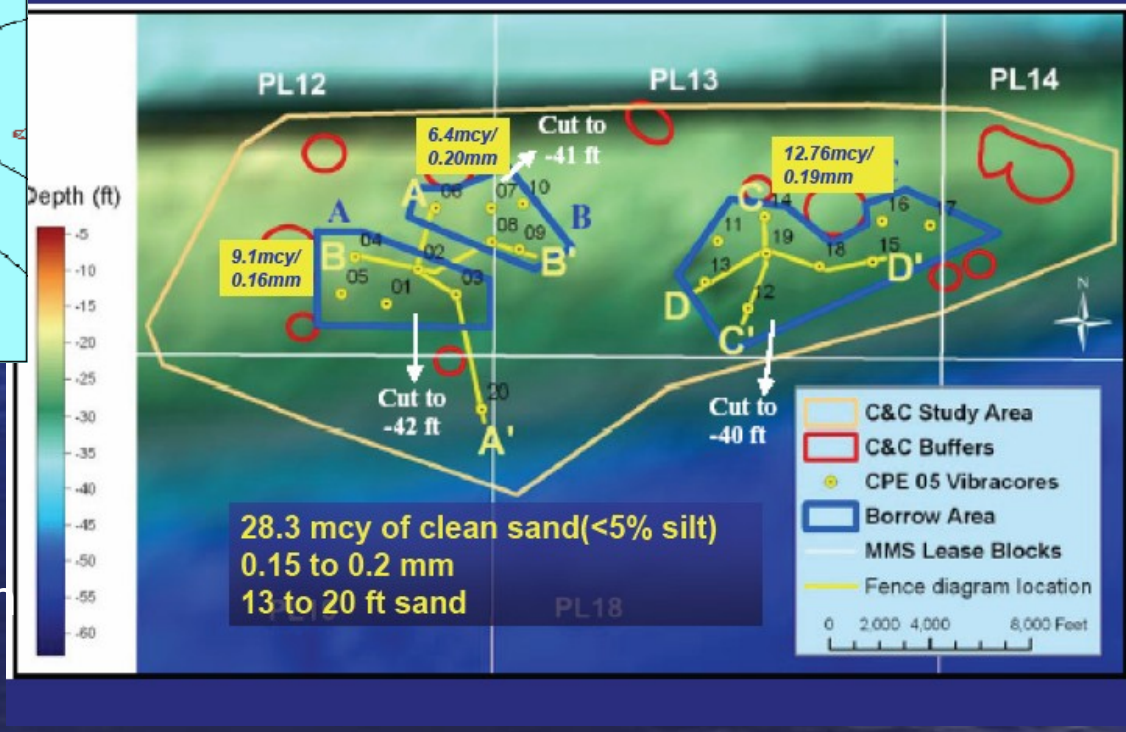
Louisiana Department of Natural Resources



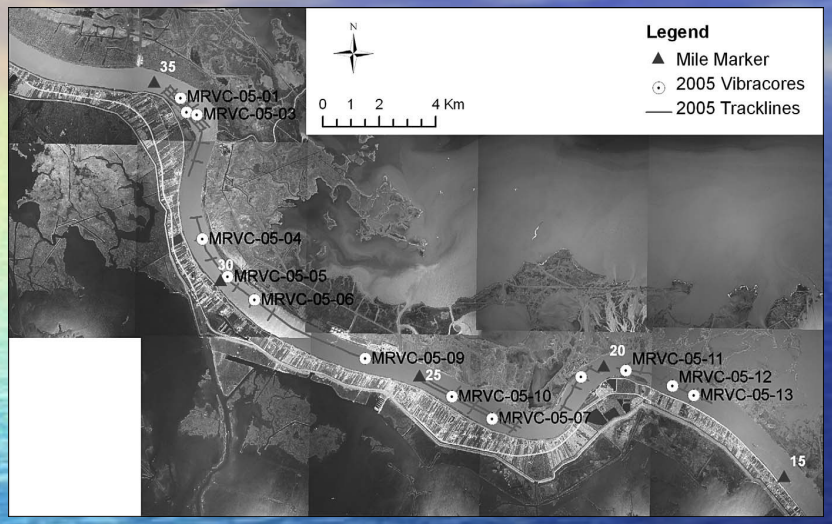
- Shoals
- Abandoned Delta Complexes
- Ebb & Flood Shoals in Modern & Relict Inlets

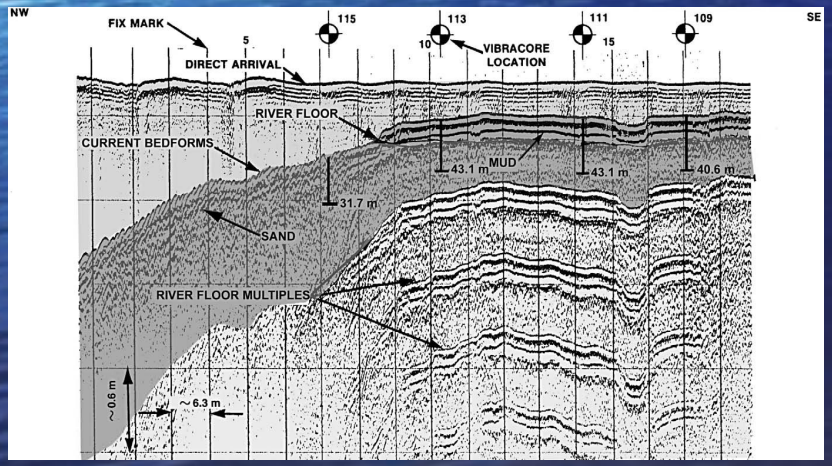
Fluvial Sands (Mississippi River)

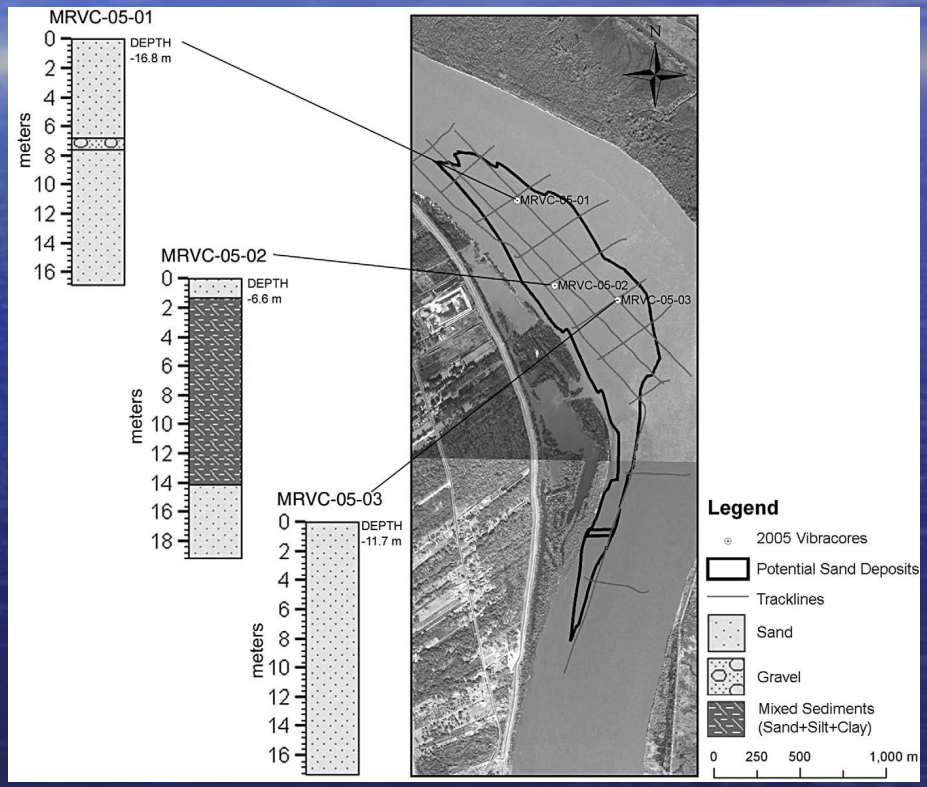
South Pelto Blocks 12 &13 – Sand Reserve



Fluvial Sand Sources in the Mississippi River

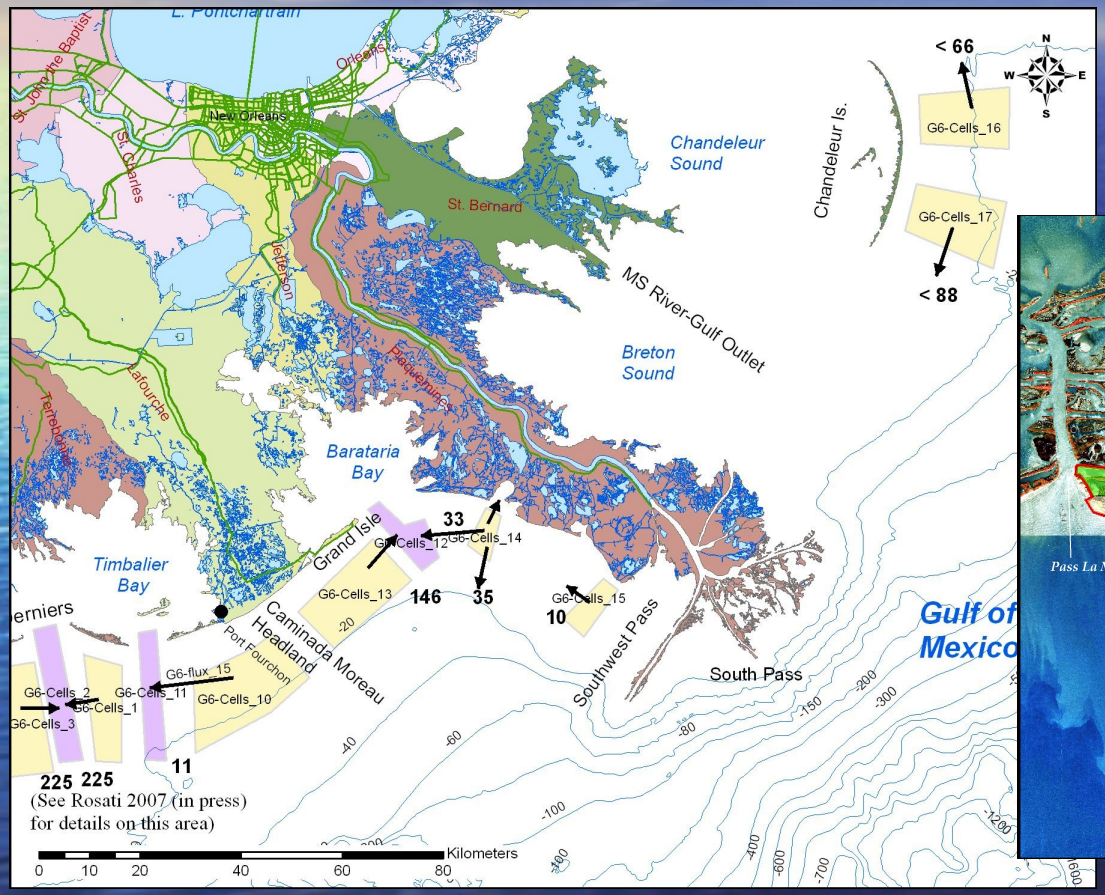


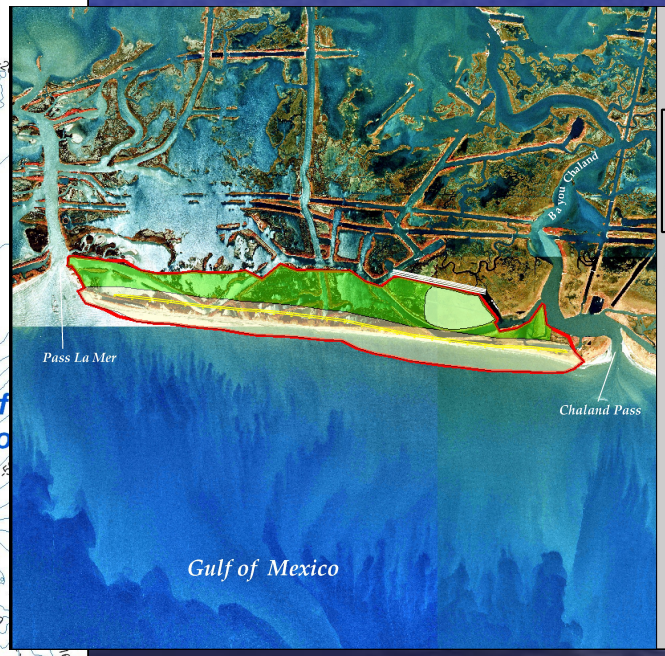


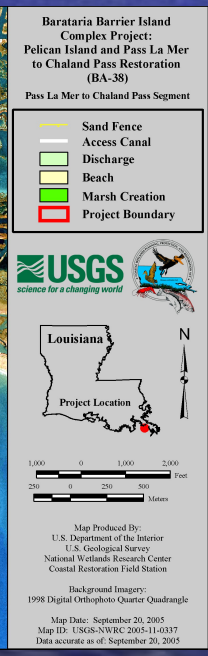


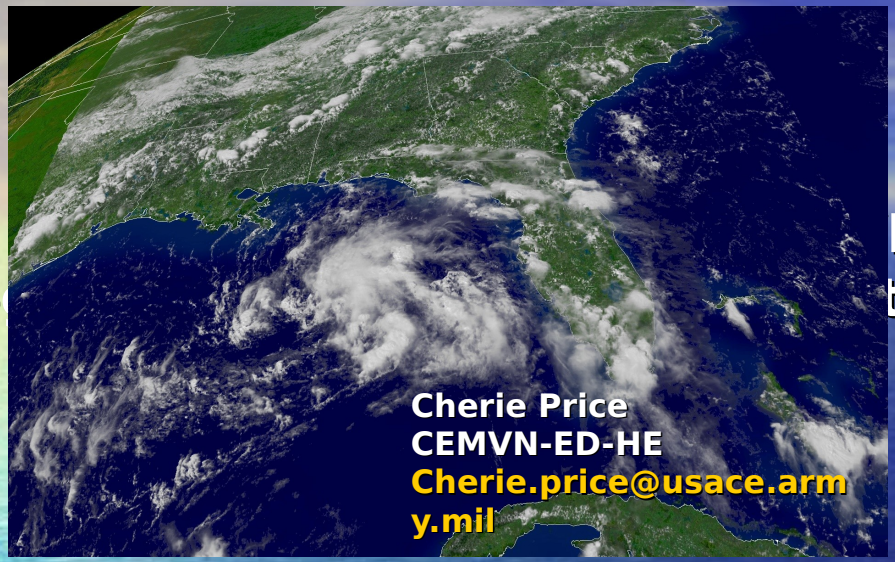
Finkl et al., 2006

Sediment Budgets in Coastal Louisiana









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Cherie.price@usace.army.mil

Louisiana Coastal Area Science & Technology Office

Future Research Needs and Technical Capabilities

- Sediment transport processes in heterogeneous sediment systems
- Depth of Closure – engineering definition is limited – Physics not understood for sediment transport from offshore to shoreface